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**Production Process Improvement for Sewing Strip Labels to
Collar Bands**

Revised Final Report

**A Short Term Research and Development Task
Proposed Under DLA900-87-0017
Delivery Order #0010**

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13. ABSTRACT (Maximum 200 words) <p>A strip label is a narrow strip of ribbon, usually attached by the narrow ends to the middle of the inside collar band of dress shirts and blouses. The label gives the customer information about the product. This project was concerned with the development of better methods using automation to attach strip labels without disturbing subsequent operations.</p> <p>The collar band consists of two pieces of fabric and interlining attached to the collar to make it stand up. Traditionally the shirt collar bands were assembled manually, about fifteen years ago an automated method of manufacturing was invented. This first generation totally eliminated five operations in the process.</p> <p>This generation was semi-automatic. One of the most difficult obstacles in apparel automation has been overcoming the inability of machinery to separate and pick individual plies of fabric. The Jet Sew 3002 incorporates a device called the Clupicker automatic feeder. The Clupicker is a device that can automatically separate and pick up single plies of fabric from a uniform stack. The band ends of the Clupicker must be in perfect alignment for the Clupicker to work properly.</p>				
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1.0 Introduction, Background and Research Objectives

1.1 Introduction

A strip label is a narrow strip of ribbon, usually attached by the narrow ends to the middle of the inside collar band of dress shirts and blouses. This small label gives the retail customer information about the product, and includes such information as brand name, fabric content, size, washing instructions, or country of origin. The information contained on the strip label is highly visible in the packaged appearance of the shirt/blouse, and is not only used to inform the customer of the contents but it is also used for aesthetic purposes.

This project was concerned with the development of better methods using automation to attach the strip labels without disturbing subsequent operations.

1.2 Background

The collar band consists of two pieces of fabric and interlining attached to the collar to make it stand up. Traditionally shirt collar bands were assembled and attached to the collar by a manual process, about fifteen years ago an automated method of manufacturing was invented. This method called "band creasing" and "automatic band stitching", involves a process of heat fusing/molding the interlining to the banding fabric and then automatically stitching two bands to the collar. The first generation of this technology totally eliminated five operations in the process.

This generation of the band crease operation was semi-automatic. The operator would manually pick up one ply of fusible interlining, place it on one ply of banding fabric, align the plies and place them in the creasing machine. Next, the creasing machine would automatically fold the edges of the fabric around the fusible interlining. Then using a combination of heat, pressure and dwell time it would fuse the assembly and automatically dispose of the finished band into a box or tray. In this stage of the evolution the strip labels were attached prior to the creasing operation. The traditional flow of the label sewing process involved the following:

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- Tying and removal of cut bundles of bands from the cutting table.
- Staging and transporting the tied bundles to the strip label sewing operation.
- Untying the bundles and placing them in a clamping device on the sewing machine table.
- Attaching the strip labels using a cascading or waterfall method.
- Removing the bands from the clamping device and retying the bundles.
- Staging and transporting the tied bundles to the band crease operation.
- Untying the bundles and placing them horizontally in a tray on the band crease machine.
- Loading the band and interlining into the band crease machine.

At the label sewing operation one end of the untied bundle is placed in a clamp to one side of the operator. The sewing machine table would have a cut-out section between the clamp and the needle. After the bundle of bands have been clamped, the entire bundle is flipped back away from the operator. Beginning with the bottom ply of the bundle bands, one at a time they are manually picked up and placed under the needle for the labels to be attached. The bands have notches in the center to give the operator a guide for centering the label. When the operator has determined a center, the label is then sewn at both ends and disposed into the cut out portion of the table while remaining clamped at one end. This process is repeated until the entire bundle is completed. After the strip labels are attached to the inside band, the added thickness of the label creates a hump in the center of the sewn bundle. A combination of the hump and handling processes tend to misalign the ends of the bands. This hump and misalignment did not present a problem until the introduction of the Jet Sew 3002 automatic band crease feeder. This piece of equipment replaces the manual method of loading the individual subassemblies of bands into the creasing machine.

One of the most difficult obstacles in apparel automation has been overcoming the inability of machinery to separate and pick individual plies of fabric. The Jet Sew 3002 incorporates a device called the Clupicker automatic feeder. The Clupicker is

a device that can automatically separate and pick up single plies of fabric from a uniform stack. The automatic process using the 3002 flows as follows:

- The operator places bundles of band plies and lining plies into the Clupicker's loading magazine.
- The Clupicker picks up an individual band ply and a lining ply simultaneously.
- The plies are transferred to a loading platform.
- The individual plies are oriented in the x and y axis.
- A pick-up device pre-assembles the plies.
- The pre-assembled plies are placed in the creaser for fusing.

With this concept the operator loads entire bundles of bands and interlinings into the magazine allowing a single operator to operate multiple machines. The original Jet Sew 3002 was designed to load and crease bands without the strip labels being attached. The problems with using the Clupicker incorporated with the conventional method of attaching labels are, the added thickness in the middle of the bundle plus all the previous handling operations distorts the ends of the bands. The band ends must be in perfect alignment for the Clupicker to work properly.

1.3 Research Objectives

The primary goals of this project were to investigate the feasibility of developing the following:

- New methods of attaching strip labels.
- Better clamping devices to keep the integrity of the band ends aligned throughout the process.
- Machinery that could straighten misaligned band ends.
- Modify the existing Jet Sew loader to accommodate the inconsistency of the band ends.
- Investigate ways to attach the labels after the creasing process.
- Modify the Jet Sew loader to accommodate the "hump" in the bundles created by the strip labels.

2.0 The Approach

2.1 Investigation of various research objectives

The method of manually attaching the labels after the creasing operation using the conventional clamp and waterfall method posed two major problems. First, after the bands have been creased, the notch used to determine the center of the band is turned under the bottom edge of the finished band and is no longer visible to the operator. This makes it very difficult to sew the strip label in the proper position. The second problem involves excessive handling of the bands. The clamping mechanism used on the sewing machine damages the crease thus rendering the bands unusable at the next operation.

The use of some type of automatic sewing equipment to attach the labels after the creasing operation also posed several problems. The consideration of coupling an automatic label sewer to the band crease machine seemed to be a feasible possibility. The theory was to have the creaser deliver the finished band into the label sewing machine rather than into a box. There were two logistical problems with this idea. First, the cycle times between the two operations are not compatible. Since the sew time is much longer than the creasing cycle it prevents full utilization of the band creaser. Secondly, since the band lengths vary with different sizes and styles detecting the center of the band would involve very sophisticated electronics that would be very difficult to install and expensive to the machine manufacturer. The third difficulty involves the inability to adapt an automated label sewer to different brands of band creasers (i.e., Adler or Ideal).

In this phase of the project it was learned that Jet Sew had manufactured a prototype machine which interfaced with their band creaser and a Brother automatic strip label sewing head. The entire system picked the bands from a bundle, creased the band, delivered one band at a time to the sewing head positioned the band, sewed the strip label to the band and restacked the labeled band for subsequent processing. According to Jet Sew the system worked well but was commercially a failure because of its cost.

The fact that Jet Sew was unable to produce a fully automatic strip label system but unable to market it indicated to Clemson Apparel Research that it would be unfeasible to try and fully integrate an automated system.

The idea of designing a device to straighten the bundles after the conventional method of cascade label sewing involved the use of cameras and robots. While this process could feasibly be accomplished, again it would be very time consuming and expensive. Thus alternative solutions to the problem were sought.

Several different methods of attaching the strip labels were considered. The first step involved refining current pre-creasing strip label sewing methods to better interface with automated band creasing equipment. End alignment is very critical to the success of the pick operation in automated band creasing. Since the cascade sewing method physically limits bundle ply-shifting by clamping one bundle end, the cascade sewing method was well-suited as a starting point for pre-creasing sewing methods development.

The main way to improve the pre-crease strip label cascade sewing method is to minimize excess bundle handling (tying, untying, and manual realigning) both before and after sewing. Rigid mechanical clamps were found to minimize the negative effects of bundle handling. Of the various clamps experimented with, one type of office paper clamp was found to be inexpensive and to apply sufficient clamping force to limit bundle-end distortion. Unfortunately, the office clamp tested had limited clamping capacity and was awkward to handle.

The solution to the handling difficulties was a flatter, easier to open, and slightly more expensive binder clamp. Also, the holes in the handles of the more expensive clamp allowed the clamps to be hung from hooks or nails. Since in the cascade sewing method, plies of material hang after sewing, experiments were done to modify and integrate the new binder clamp. Problems, however, arose due to the fact that the smaller clamps were unfeasible because one could not support the weight of a large bundle of material. Initial ideas had a single clamp supporting the entire weight of a large bundle. The use of large clamps was met with a number of serious contentions, not the least of which concerned the cost of using large clamps.

We chose to modify the clamps in various ways in order to identify the most feasible configuration. The first clamp modification (see figure 1) has the advantage that both clamp halves can move with respect to the spacer. This means that the clamp modification can accommodate a larger variety of spread heights than the modifications that allow only one clamp half to move. The disadvantage turned out to be that a second complete set of clamps is required to make the clamp modification. The clamps are made in Japan; therefore, the clamp springs could not be purchased separately. This means that for every one modified clamp made, two normal clamps must be used, which made this modification too expensive for consideration.

The second clamp modification (see figure 2) rigidly joins the spacer to one of the clamp halves. This modification saves money from the input material perspective, but overall costs more because of expenses incurred in fastening the bottom half of the clamp to the spacer. The figure shows the joint as a welded connection which is expensive and difficult to make. Coupled with the reduced ability of the clamp to accommodate different sized spreads due to the bottom half of the clamp being welded, the figure 2 modification was not satisfactory.

In the figure 3 modification, we discarded the bottom half of the clamp. Replacing the bottom half of the clamp is a spacer bent to mimic the form of the discarded clamp half. The figure 3 modification cannot accommodate the same spread variations as the figure 1 modification, but the figure 3 modification is relatively inexpensive. It is also less expensive than the figure 2 modification. Figures 4 and 5 show a feed mechanism attached to the figure 3 modification. Figure 4 shows a vertical gravity feed mechanism with the bottom of one clamp pushing on the top of the clamp below it. Figure 5 shows a horizontal feed mechanism with the front of one clamp pushing on the back of the clamp in front of it. Both of these feed mechanisms are bulky and unreliable.

Figure 6 shows a solution to the problems discovered in figures 4 and 5. It is a clamp feed mechanism that feeds clamps by having the clamps push on each other's sides. This clamp feeding mechanism is easy to load, reliable, flexible, and inexpensive. It also has the advantage of using IDL clamp geometry. IDL clamps have flat sides which allow clamps to easily push on another. The clamp geometry selected is shown in figure 7. Construction of the clamps is such that the clamp

'teeth' run parallel to each other. This mechanical attribute, coupled with the clamp's flat sides, makes a feeder like the one shown in figure 8 ideal. The feeder's tapered guides make the loading of used clamps as simple as pushing, and the high guide fronts ensure that the guides are rigid and that the clamps are properly located and not pushed too far. Also, the use of a manually cocked spring to feed the clamps and a ratchet type mechanism allow one clamp to feed at a time, which greatly simplifies clamper control.

We also found that by rounding the IDL clamp teeth and by tapering the feeder guides, the pushing action of the feeder could actually engage the clamps into a bundle (see figure 9). It is very important that the gap between the guides match the bundle heights of cut pieces as they come of the cutter and that the gap is unobstructed for some distance from the clamping zone. These points are important because too narrow a gap-Y dimension and a bundle will not slide under the clamp; too short a gap-X dimension and the odd shaped bundles will be unable to fit into the clamping zone. However, the clamp advancing device of the feeder must also be considered.

A feed device imitating the advancing mechanism on manual caulking guns was considered; however, it was determined that it would be too fatiguing to use a manual trigger advancing device in conjunction with lifting and moving the entire loaded clamper.

In November of 1990, Mr. Randy Rowland assumed responsibility for the project in order that Mr. Tony Aspland could focus more attention to the chemical protective suit and air-flotation projects.

After assuming responsibility for the project several contacts were made with The Jet Sew Corporation concerning the feeding problems with the 3002 automatic pick up device. It was then learned that Jet Sew had modified their loading magazine in such a way that it would accommodate the "hump" in the middle of the bundles of pre-sewn bands. As a result of this information, it was suggested by Jet Sew that we focus our attention on a clamping device to transport the bands from the cutting room the label sew and band crease operations.

The first prototype clamp was designed by Mr. Randy Rowland and Mr. Elroy Pierce. The device was constructed by a local machine shop using an eighth aluminum sheeting and a one-half inch rubber strip as the holding mechanism. The intention of the design was to clamp the bundle of bands at the cutting table and transport the clamped bundle to the label sewing machine. There the labels would be sewn and transported to the band crease loading magazine where they would be carefully removed from the clamp and placed into the loading magazine. The prototype was successfully tested at the Clemson Apparel Research facility.

Mr. Rowland and Mr. Pierce took the prototype to The Philips Van Heusen Corporation in Ozark, Alabama for field testing. For the most part, the prototype was well received. However, removing the bands from the clamp at the band crease loader was considered a disadvantage. In addition, Van Heusen was in a transition period of moving their loading equipment from one plant to another. However, they supplied the principal investigator with patterns of various band styles and sizes used so that a universal clamp could be developed to accommodate the extremes. They also suggested that we design a cassette type of clamp that could simply be inserted into the loading magazine without having to remove the bands from the clamp. This possibility was investigated and again it was found that it would require extensive modifications to the band crease loader which would be cost prohibitive.

Using the data provided by Van Heusen, we constructed a second generation prototype band clamping device. However, it was not tested at Van Heusen due to some production problems at their plant. Instead, the device was tested at CAR and determined to be adequate for holding the collar bands while being transported.

At this phase of the investigation we felt that the basic design of the aluminum clamp would meet the requirements of the project and that we should proceed with more extensive testing. Again a local machine shop constructed six prototype clamps from a heavier gauge of aluminum.

The next obstacle was designing a method of temporarily holding the clamp to the label sewing machine. The holding device needed to be one that would quickly and easily secure the clamp to the table top. It also needed adjustability to allow the

clamp lateral movement. The lateral movement was needed to accommodate different lengths of bands. A lever type, toggle action, hold-down clamp (Model 210U from a company called DE-STA-CO), was found to be suitable for this purpose. (DE-STA-CO, P.O. Box 2800, 150 Park St., Troy, MI 48007-2800) This hold-down clamp is a durable inexpensive attachment that is readily available.

At this point, we were able to place the collar bands in the cassette device and transport them from the cutting table to the strip label machine. During the label sewing process, the bands remain in the device. After the label sew operation is completed, the bands remain in the clamp until they reach the band crease machine. Then they are removed from the clamp and placed in the automatic feeding device for the creaser. Then the empty clamp returns to the cutting table, thus completing the cycle.

3.0 Testing

3.1 Lab Testing

The prototypes were tested at Clemson Apparel Research. We were able to transport the clamped bands from the cutting table, through the subsequent operations and to the band crease machine without disturbing the integrity of the band ends. The overall performance was very positive.

3.2 Field Testing

Finding a suitable manufacturing operation to field test the product has been difficult. The Van Heusen Company, originally scheduled to field test, changed their production requirements in such a way that they no longer use the automatic loader. The only known manufacturer using the loader is Capital Mercury Shirt Company, and they have a closed door policy in their facilities.

4.0 Conclusion

We feel that the project investigation and hardware construction has been completed at this time. Unfortunately the prototypes have not been adequately field tested due to changes in styles and production requirements. Although it is difficult to quantify the benefits to the apparel industry without proper field evaluation of the units, we believe that the project was worthwhile. The prototypes constructed during the course of this project can provide information for future development. In addition, our research explored the possibility of pre-loading the bundles and changed the perspective of work to explore ways to work with poorly loaded materials. This particular aspect of the research could be expanded and possibly utilize the new clupicker that Dr. Tim Clapp at NC State University has developed as a result of a subcontract from DLA through CAR.

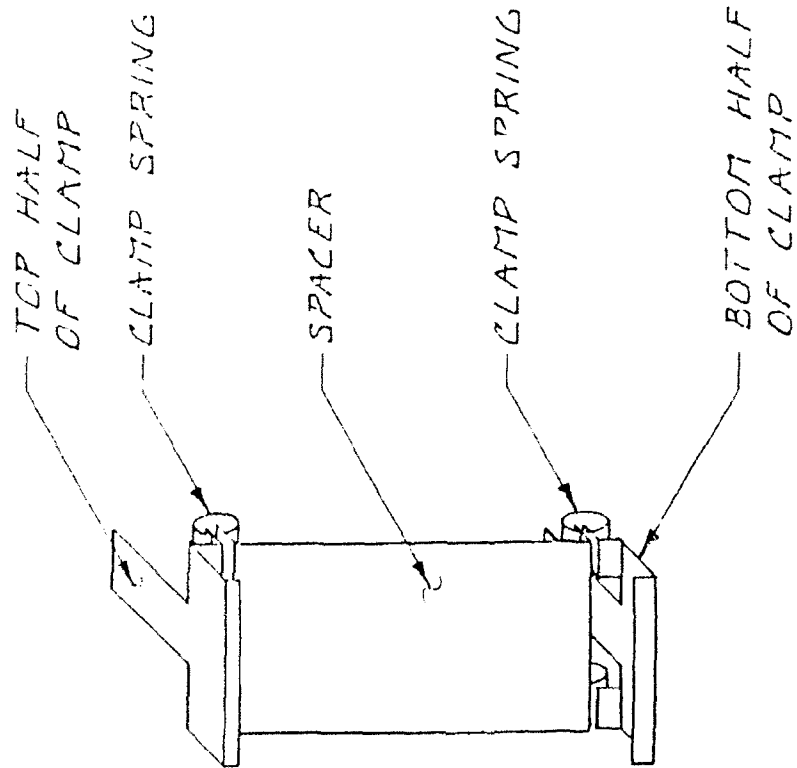


FIGURE 1

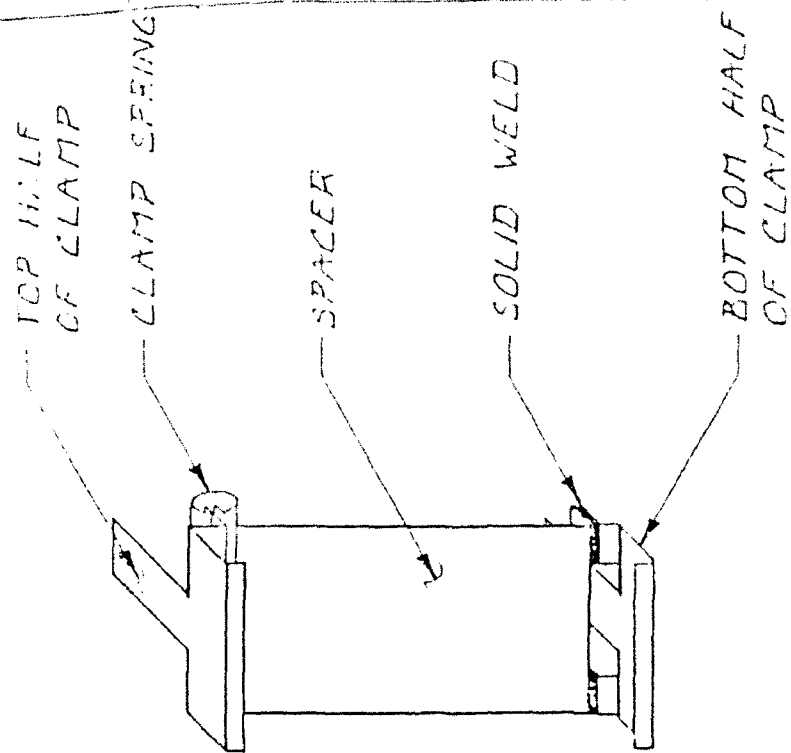


FIGURE 2

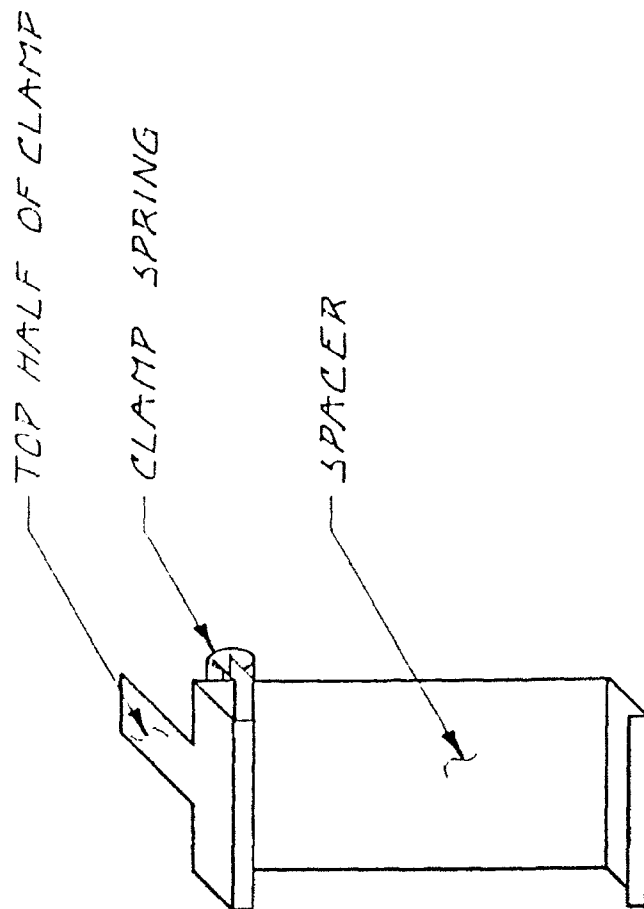


FIGURE 3

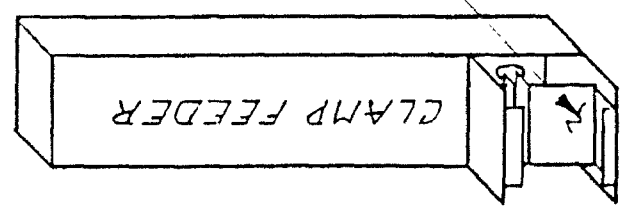
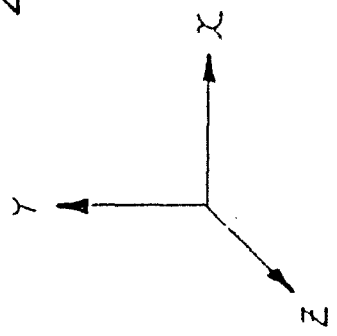


FIG 4

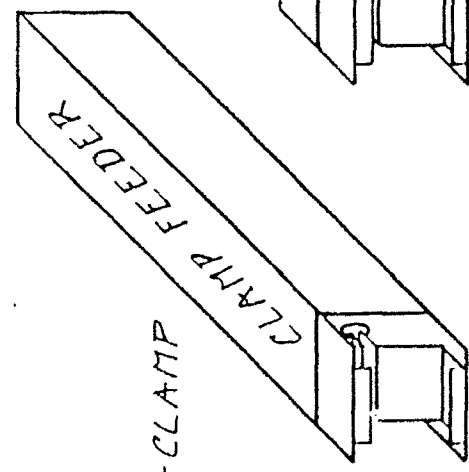


FIG 5

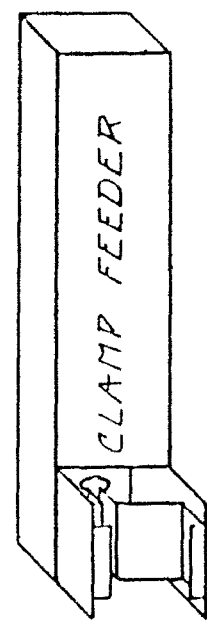


FIG 6

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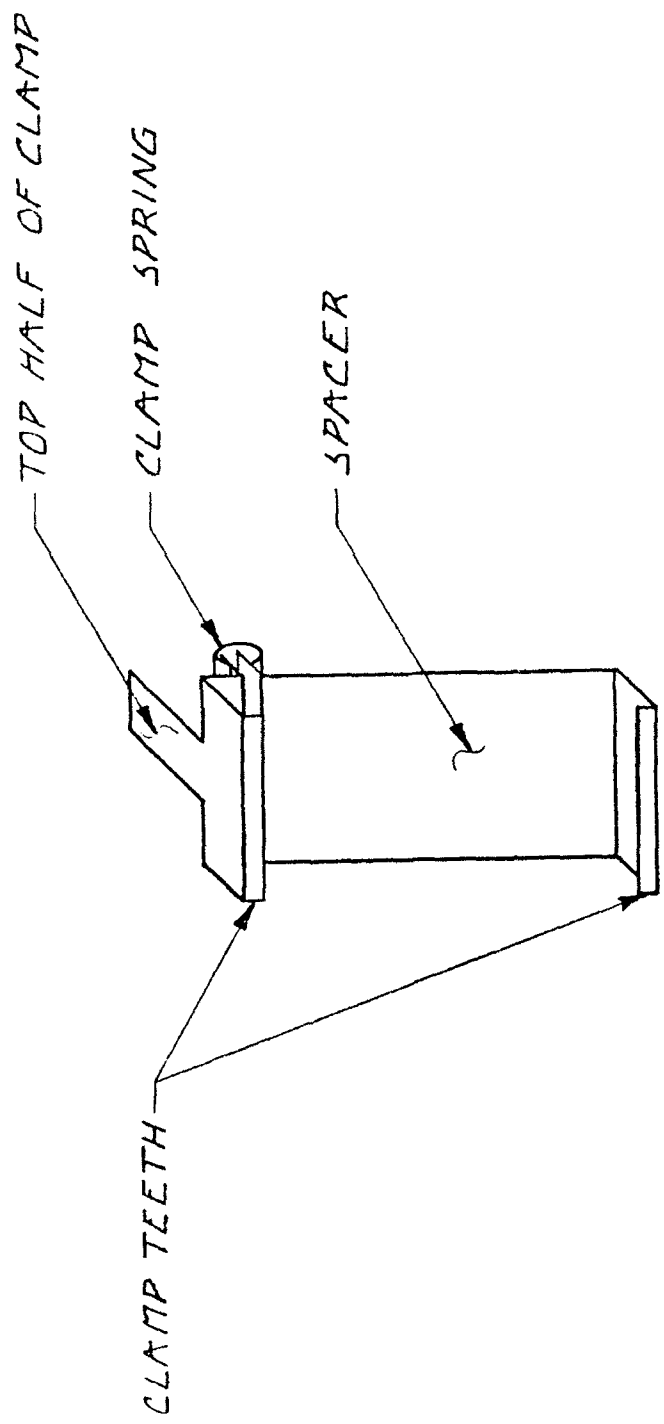


FIGURE 7

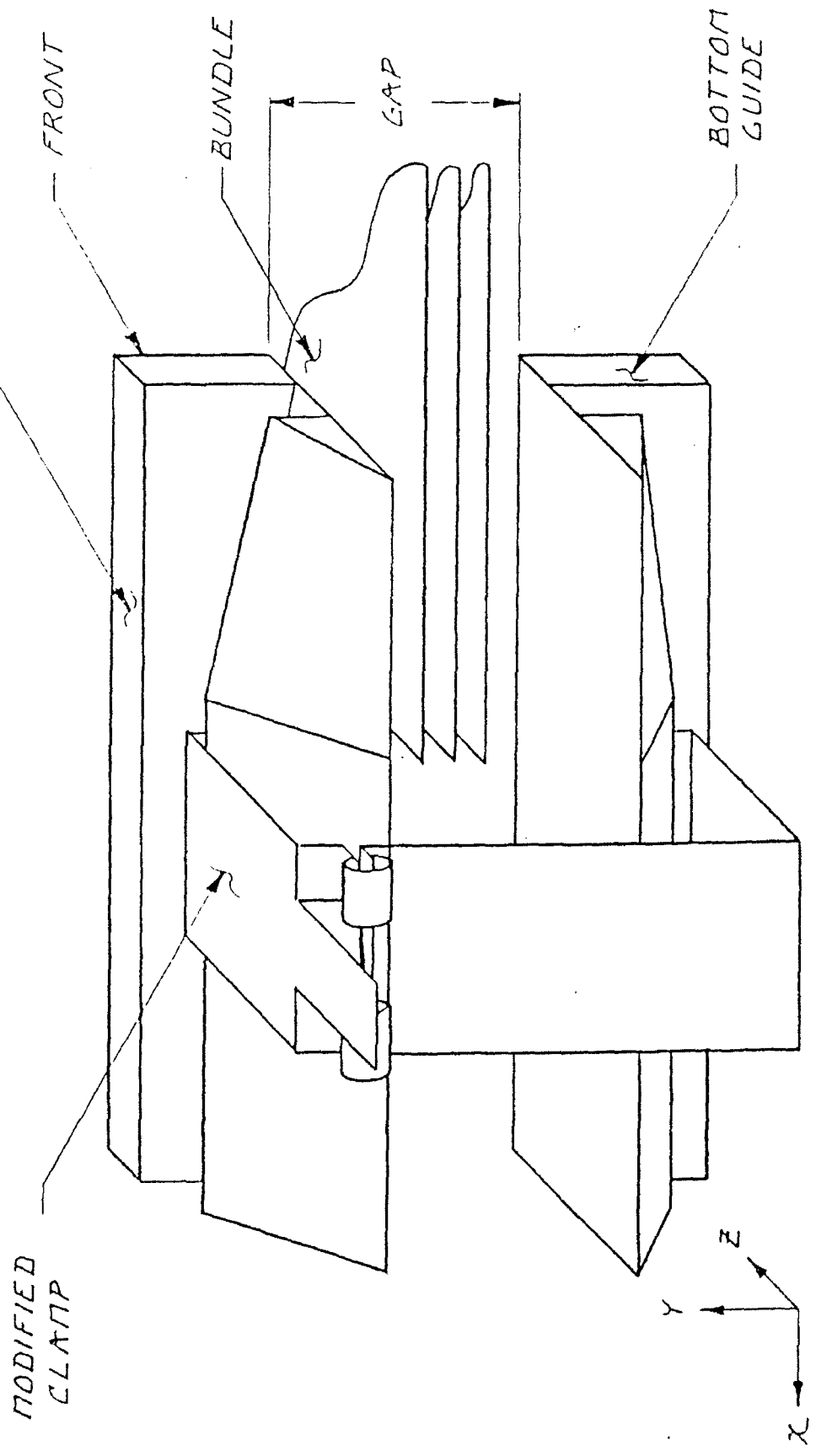


FIGURE 9 CLAMP FEED MECHANISM
(REAR VIEW)